CALIFORNIA DIVISION OF MINES AND GEOLOGY

Fault Evaluation Report FER-32

March 24, 1977

1. Name of fault: Carpenteria fault.

2. Location of fault: Carpenteria and White Ledge Peak quadrangles, Santa Barbara County, California (see figure 1).

3. Reason for evaluation: This fault is in the 1976 study area of the 10-year program for fault evaluation in the state. Also, the Santa Barbara County Seismic Safety Element (Moore and Taber, 1974) classifies this fault as "potentially active."

4. List of references:

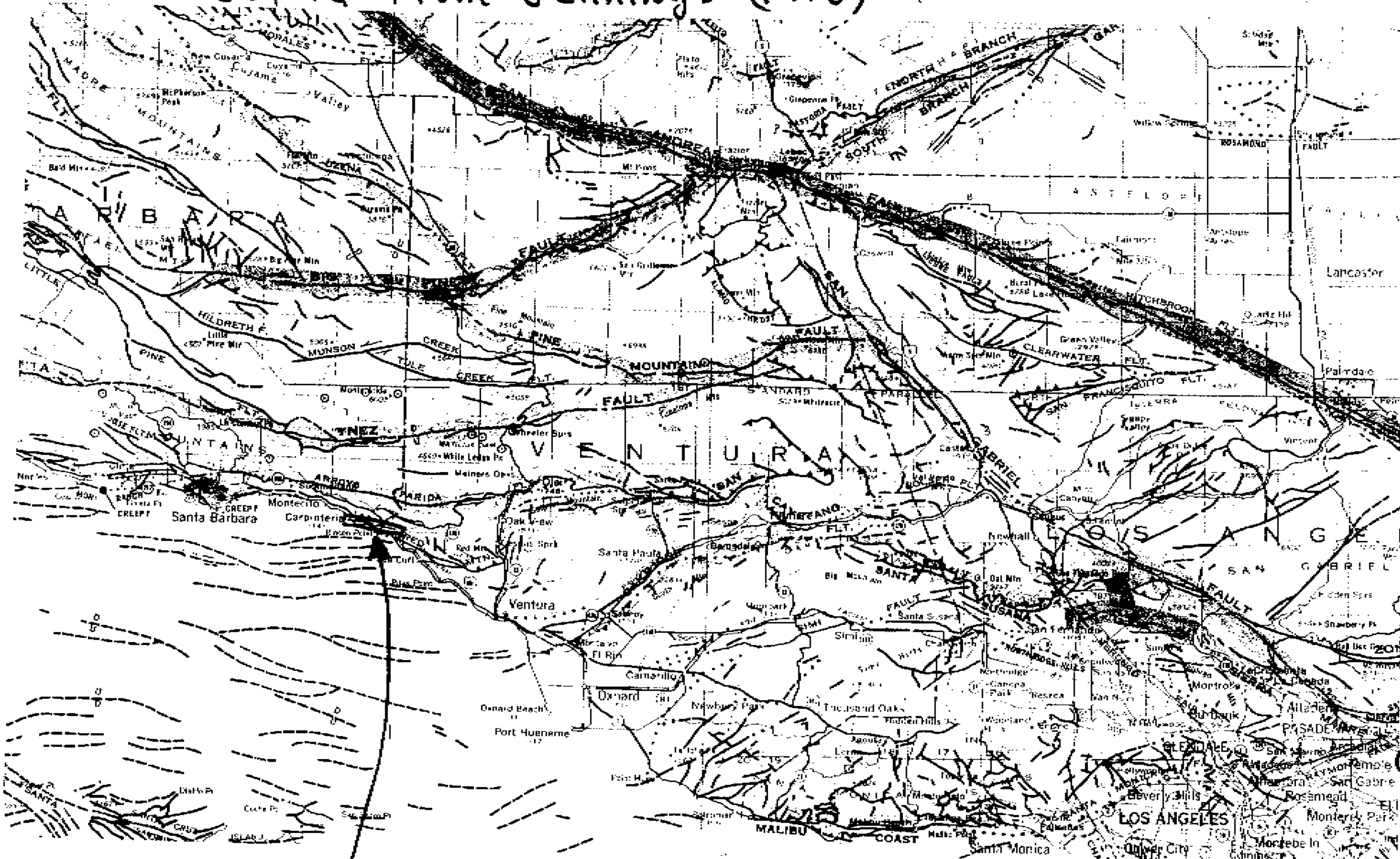
a) Dibblee, T.W., 1966, Geology of the central Santa Ynez Mountains, California: California Division of Mines and Geology, Bulletin 186, 99 p., plate 2 (scale 1:31,680).

b) Jennings, C.W., 1975, Fault Map of California: California Division of Mines and Geology, California Geologic Data Map Series, Map no. 1, scale 1:750,000.

c) Jennings, C.W., Troxel, B.W., 1954, Geologic Guide -- Ventura Basin in Geology of southern California, California Division of Mines and Geology, Bulletin 170, Guidebook no. 2, 63 p., Map 16 (scale 1:62,500).

d) Kew, W.S.W., 1933, Excursion from Los Angeles to Santa Barbara in International Geological Congress, XVI session, United States, Guidebook 15: Excursion C-I, p. 48-67.

Copied From Jennings (1975)



Carpenteria fault

Fig 1

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e) Lian, H.M., 1952, The geology and paleontology of the Carpenteria district, Santa Barbara County, California: University of California at Los Angeles masters thesis, 178 p., plate 1 (scale 1:12,000).

f) Moore and Taber, 1974, Santa Barbara County comprehensive plan -- Seismic Safety Element, 93 p.

g) Upson, J.E., 1951, Geology and ground water resources of the south-coast basins of Santa Barbara County, California: U.S. Geological Survey, Water Supply Paper 1108, 144 p., plate 1 (scale 1:31,680).

h) Ziony, J.E., Wentworth, C.M., Buchanan-Banks, J.M., Wagner, H.C., 1974, Preliminary map showing recency of faulting in southern California: U.S. Geological Survey, Miscellaneous Field Studies Map, MF-585, plate 1 (scale 1:250,000).

i) Fairchild aerial photographs, 1929, roll C297B, frames A1 and A2, on file at Whittier College.

j) Smith, T.C., 197~~8~~7, Red Mountain fault, California Division of Mines and Geology, Fault Evaluation Report, FER-21 (unpublished report)

5. <u>Summary of available data:</u>

The Carpenteria fault is a four-mile long, east-trending feature (see figure 1) that is shown on small scale maps of Ziony (1974) and Jennings and Troxel (1954). There is some disagreement as to the fault's surface location, based on more detailed maps of Lian (1952) and Upson (1951) (see plate 1 in this report). This disagreement stems from the fact that the Carpenteria fault is actually a fault-zone of some width.

The fault probably extends offshore and may connect with the Mesa fault in the City of Santa Barbara to the west (Dibblee, 1966, p. 70). To the east, the fault may connect with the Red Mountain fault (Ziony, 1977; also see Smith, 1977). However, the Red Mountain is a north dipping thrust fault and the Carpenteria fault dips to the south so their relationship is uncertain.

The Carpenteria fault is a south-dipping, reverse fault (Dibblee, 1966; Upson, 1951; Lian, 1952). The dip of the fault plane, as identified in oil test holes, is from 45 to 65 degrees (Dibblee, plate 2, section H-H). Dibblee, who doesn't show the fault on his map, shows 4500 feet of stratigraphic separation of the base of the Rincon Formation (middle Miocene). He shows the Casitas Formation (lower Pleistocene) to be the youngest unit truncated by the fault. A photograph of an old U.S. 101 Highway cut west of Rincon Creek (Kew, 1933, plate 13b) shows the Monterey Formation to be thrust over late Pleistocene terrace sands along a "minor branch" of the Carpenteria fault (see figure 2). However, as can be seen in the photo, a younger (late Pleistocene?), unfaulted terrace deposit overlies these units (also see Kew, p. 67).

Both Dibblee and Kew noted that the fault is not exposed anywhere in the lowlands near Carpenteria. However, Kew states (p. 67) that "sand ridges and an intervening depression" mark the surface expression of the Carpenteria fault toward the west. Ziony (1974) also identifies possible fault related topographic features in this area. He classifies this fault as Holocene on this basis. Specifically, Ziony (personal communication, 1977), identified a closed depression on the north side of the fault. This depression has since been obliterated by grading.

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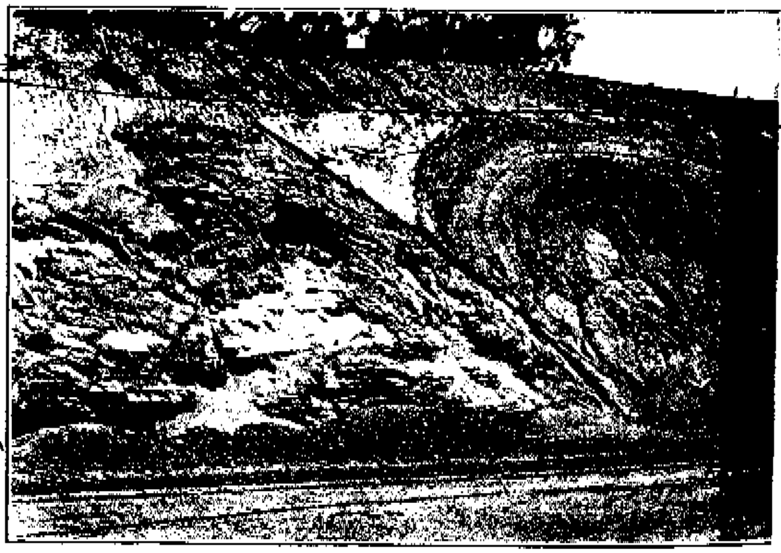
Fig. 2

Looking east in old U.S. 101 roadcut

Younger terrace deposits overlying Tml on south and older terrace deposits on north.



Copied from Kew, 1933

Plate — 13 *B.* SMALL REVERSE FAULT IN ROAD CUT ON NORTH SIDE OF RINCON CREEK, SANTA BARBARA COUNTY

Modelo (upper Miocene) shale is overriding unconsolidated sand of Pleistocene age

Monterey shale

6. Air-photo interpretation:

So far the only photos looked at covering this area are those in the Fairchild collection. The area at locality 2 (plate 1) shows up as a trough open to the northwest. The southeast end of this trough is identified by Ziony, et al. as a closed depression.

Photo coverage farther to the west may be on file at the U.S. Geological Survey but as yet I have not been able to see them (see 4/4/77 supplement to FER-32 at end of this report)

7. Field observations:

The following numbered observations are correlated with the numbers appearing on plate 1 in this report.

1) A 2,500-foot long, north-facing escarpment is visible between the arrows at locality 1. This escarpment is about 200 feet wide and 25 feet high. It slopes upward to the south at about a 10 degree angle. It can't be determined, without subsurface work, if the escarpment is erosional or a result of movement along the Carpenteria fault. Soil development is poor in this area. The surface materials in this area are mainly well-sorted, wind-blown (?) sands. The escarpment loses definition to the west and the area to the east has been graded. The feature does not lie on any mapped trace of the Carpenteria fault.

2) This area (between the two arrows) shows up on older photos as a linear trough. This feature lies between the faults shown by Jennings and Troxel and by Upson, which are shown to 300-400 feet apart. Recent construction in the area has obliterated any remainder of this feature.

Locations 3, 4, and 5 are difficult to portray on current available topographic maps. The reason is that U.S. Highway 101 has been widened and slightly re-aligned in this area and the road cuts are now different than shown on plate 1. Hence, these localities are shown as approximately located. Photos (figures 3, 4 and 5) have been included to aid in discussion.

3) See figure 3 with accompanying photo. Carpenteria Formation (middle Pleistocene) is faulted against Monterey Formation (Miocene). The Carpenteria beds have been upturned near the fault and appear to be dragged. This drag indicates the north side of this fault has been down-dropped relative to the south side. As can be seen in figure 3, a younger (late Pleistocene?) terrace deposit overlies these units and the fault and appears to be unfaulted. The strike of the sheared beds near the fault contact with the Carpenteria beds is N. 80° W. Sheared and faulted, steeply-dipping and contorted Monterey strata are continuously exposed to the south for 500-700' beyond the photo.

4) The bracketed area at locality 4 is a continuation of the roadcut described at locality 3. Here, the Monterey beds are sheared, steeply dipping, and locally highly contorted (figure 4). Although the beds are nearly vertical. The age of faulting in this section of rocks is also difficult to determine. Younger terrace materials overlie the Monterey rocks locally here, but not everywhere. However, the lack of a scarp in the upper erosion surface suggests the absence of recent dip-slip fault displacement.

5) See figure 5 with accompanying photo. This locality, on the west side of U.S. Highway 101, shows Monterey Formation on the south in fault contact with a sandy terrace material. At the contact a three inch wide gouge zone can be seen. The gouge zone is nearly vertical and the Monterey rocks have the same attitude as the gouge (N. 65° W. strike).

Fig. 3

U.S. 101 ROADCUT

60 feet
Scale

View looking east—Monterey Formation on the south faulted against Carpenteria Formation on the north.

Tml = Monterey Formation
Qcp = Carpenteria Formation
Qt = terrace deposit
—— = Fault

Fault N80°W - nearly vertical Dip

Sheared Tml beds

Contact $\frac{Qt}{Qcp}$

$\frac{Qt}{Tml}$ Contact

Near vertical Tml beds

Qcp beds upturned as they near the fault.

Fig. 4

View looking east at locally highly contorted Monterey Formation beds. ~~rocks~~. Red line at south end of roadcut defines the boundary between contorted beds (left) and vertical beds which are not contorted (see locality 4).

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Fig. 5
U.S. 101
Roadcut

6 ft
Scale

View looking west — Monterey Formation on the south faulted against Quaternary terrace deposits on north.

Tml = Monterey Formation
Qt = sandy terrace deposit
= Fault

3" fault gouge

Tml

Qt

Fault N65W
Vertical dip

This fault strikes in the direction of the contorted Monterey rocks to the southeast, but no discreet fault on the east side of the highway could be matched with it. ~~although~~ The fault identified at locality 3 appears to lie about 100' north of this fault. Although it can not be seen in the photo in figure 5, an approximately five-foot thick terrace sand overlies these units and appears to be unfaulted.

8. Conclusions:

The available literature on the Carpenteria fault is conflicting as to the nature of faulting. Some references (Dibblee, Upson, Kew) show the fault to be dipping between 45 and 65 degrees to the south. Yet the fault is mapped at the surface as a nearly straight-line feature. It is difficult to imagine a fault with a 45-65° dip being such a linear feature at the surface. Further, the surface expression of this fault (namely closed depression, troughs, and linear escarpments) is indicative of a strike-slip feature. Also, the faults and deformed strata exposed in the highway cut (locality 3, 4, 5) are nearly vertical suggesting a major vertical fault zone (strike-slip?)

The location of the Carpenteria fault, as shown in the literature and from my own field observations, is also in question. The U.S. 101 roadcut reveals a zone of faulting possibly as much as 1000 feet in width. At the surface this fault is expressed as a linear zone of discontinuous features. Older air photos do reveal some very suspicious features. However, none of these features clearly indicate a well-defined recent (Holocene) fault anywhere within this zone.

The possibility that the fault connects with the Red Mountain fault to the east has been considered. However, the currently postulated mechanics of these faults don't fit. The Red Mountain fault dips to the north while the Carpenteria fault reportedly dips to the south. If the Carpenteria fault is a near vertical strike-slip, feature (as discussed above), than the two faults may be part of a common structure, both in space and time.

The recency of movement along the Carpenteria fault is suspect. Ziony (1977, personal communication), noted a possible Holocene topographic feature along the terrace south-east of the City of Carpenteria. This feature, and others except for an escarpment at locality 1 (plate 1) are no longer present. He stated that a carefully placed trench could provide important evidence as to the recency of movement along the Carpenteria fault. Clearly, there is good evidence of late Pleistocene faulting in the highway exposures, although no demonstrated evidence of Holocene activity. Moreover, the two faults I observed at localities 3 and 5 (plate 1) were both overlain by younger unfaulted terrace materials of probable late Pleistocene age. However, the dist~~ributed~~urbed beds described at locality 4 could conceal an active fault.

9. Recommendations: I recommend not zoning this fault for special studies at this time. The fault is not well-defined, at least at the surface, and there is insufficient evidence to indicate that it was active during the Holocene. However, insufficient data are available to indicate the inactivity for all components of this zone and additional studies (by the California Division of Mines and Geology or Santa Barbara County) are recommended. For example, some of the scarps or photo lineaments

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west of the highway could be trenched. Also, the fault could be monitored for seismicity.

10. Investigating geologist's name; date:

Edward J. Bortugno

EDWARD J. BORTUGNO
Geologist
March 24, 1977

I agree with the recommendations not to zone and the need for additional studies of this complex structure.
EWH
4/13/77